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A BIBLIOGRAPHY OF SYSTEMIC INSECTICIDES

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The term "systemic insecticide" was given by Martin and Shaw (269) to any compound that is readily absorbed by a growing plant and translocated in the sap stream of the plant in an amount sufficient to render the plant toxic to insects that feed on it. A systemic insecticide should be effective long enough to protect the plant against insect pests during most of its growth, and yet exert no toxic effect either on the plant itself or on warm-blooded animals using it for food.

The advantages of this type of insecticide are self-evident and have appealed to the imagination of entomologists for many years. In 1936 this idea was partially realized when Hurd-Karrer and Poos (208) discovered that wheat growing in soil containing sodium selenate was not attacked by aphids or spider mites. Since then many uses have been made of this property of selenium compounds. However, selenium cannot be used to control insects on food crops because of its extreme toxicity to mammals.

A great advance was made in the field of systemic insecticides when Schrader synthesized a series of new organic phosphorus and fluorine compounds in Germany during World War II. Reports on this work published by Schrader (376) and by Martin and Shaw (269) greatly encouraged entomologists, and the claims of these reports have since been validated experimentally and confirmed by workers in England, France, Germany, and this country.

Of the various systemic insecticides reported, schradan and demeton are the most promising and the most extensively studied. In general they are effective aphidicides and miticides. Schradan has been especially studied by W. E. Ripper and his coworkers (344) in England; they called it a selective insecticide, since it kills only the insects that feed on the plants. Demeton can be used as a selective insecticide, like schradan, if it is applied to the soil or absorbed into the seeds before planting. Besides being a systemic insecticide, demeton also acts as a contact insecticide and as a fumigant. In these actions its insecticidal effect is immediate.

The most significant properties of systemic insecticides are their ability to be absorbed and translocated in the plant and their selectivity in killing the plant pests. Absorption and translocation are important because it is only in this way that the parts of a plant inaccessible to ordinary spraying or dusting operations can be protected. The selectivity of a systemic insecticide enables it to kill only plant-feeding insects without killing their predators. This selective killing helps to prevent the development of resistant strains of pests, since post-treatment populations will be held in check by beneficial insects. Systemic insecticides have been reported as showing promise in the prevention of aphid-transmitted virus diseases in certain plants.

The hazards associated with the use of systemic insecticides on food crops are not known. For this reason their use in the United States has been limited to crops such as cotton, young nonbearing fruit trees, and ornamentals. More information is required about the chemical products resulting from the metabolism of the systemics in growing plants, and their effect upon warm-blooded animals. The compatibility and chemical interaction of systemics with other insecticides and the effects of soil applications of systemics also need further study before they can be released for general use. The field for further development of these compounds is wide open, and no doubt more practical and effective insecticides, less toxic to mammals, remain to be discovered.

This bibliography was compiled for the information of those interested in the study of systemic insecticides. An attempt has been made to include all the references on the chemistry, pharmacology, and insecticidal testing of these compounds that appeared in the literature up to December, 1953. It does not include references to systemics tried on animals only. The references are arranged alphabetically according to authors, and the following key is used to indicate the subject matter:

- (1) Schradan (OMPA or octamethyl pyrophosphoramide).
- (2) Demeton (E-1059, Systox, or O-[2-(ethylmercapto)ethyl] O,O-diethyl thiophosphate.
- (3) Other organic compounds.
- (4) Inorganic compounds.

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